Research Report

Disability Trajectories in Patients With Complaints of Arm, Neck, and Shoulder (CANS) in Primary Care: Prospective Cohort Study

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Background. Nontraumatic complaints of arm, neck, and shoulder (CANS) represent an important health issue, with a high prevalence in the general working age population and huge economic impact. Nevertheless, only few prospective cohort studies for the outcome of CANS are available.

Objectives. The purpose of this study was to identify disability trajectories and associated prognostic factors during a 2-year follow-up of patients with a new episode of CANS in primary care.

Design. This was a prospective cohort study.

Methods. Data of 682 participants were collected through questionnaires at baseline and every 6 months thereafter. Disability was measured with the Disabilities of the Arm, Shoulder and Hand questionnaire (DASH). Latent class growth mixture (LCGM) modeling was used to identify clinically meaningful groups of patients who were similar in their disability trajectory during follow-up. Multivariate multinomial regression analysis was used to evaluate associations between sociodemographic, complaint-related, physical, and psychosocial variables and the identified disability trajectories.

Results. Three disability trajectories were identified: fast recovery (67.6%), modest recovery (23.6%), and continuous high disability (8.8%). A high level of somatization was the most important baseline predictor of continuous high disability. Furthermore, poor general health, widespread complaints, and medium level of somatization were associated with this trajectory and >3 months complaint duration, musculoskeletal comorbidity, female sex, history of trauma, low educational level, low social support, and high complaint severity were associated with both continuous high disability and modest recovery. Age, kinesiophobia, and catastrophizing showed significant associations only with modest recovery.

Limitations. Loss to follow-up ranged from 10% to 22% at each follow-up measurement. Disabilities were assessed only with the DASH and not with physical tests. Misclassification by general practitioners regarding specific or nonspecific diagnostic category might have occurred. The decision for optimal LCGM model, resulting in the disability trajectories, remains arbitrary to some extent.

Conclusions. Three trajectories described the course of disabilities due to CANS. Several prognostic indicators were identified that can easily be recognized in primary care. As some of these prognostic indicators may be amenable for change, their presence in the early stages of CANS may lead to more intensive or additional interventions (eg, psychological or multidisciplinary therapy). Further research focusing on the use of these prognostic indicators in treatment decisions is needed to further substantiate their predictive value.

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Nontraumatic complaints of the arm, neck, and shoulder (CANS) represent an important health issue, with high prevalence rates in general working age populations, ranging from 12% in the United States to 33% in the Netherlands and 44% to 52% in the United Kingdom.[1–4] In the Netherlands, the prevalence of chronic CANS unrelated to trauma or systemic diseases was 19%.[2]

The 12-month incidence among a primary care population aged 18 to 65 years was 9.7%.[5] About 77% of these patients experienced complaints in the upper back, neck, and shoulder, 25% experienced complaints in the elbow and arm, and 19% experienced complaints in wrist and hand.

About 19% of people with chronic CANS reported CANS-related sick leave, 39% of whom reported a duration >4 weeks.[2] In 2009, CANS was registered as the cause of almost 11% of all sick leave days in the Netherlands.[6] The yearly cost of associated benefits are about €1.4 billion. Additionally, costs due to productivity losses, disability pensions, and health care usage are estimated at €800 million, €200 million, and €150 million, respectively.[7] In the United States, upper extremity disorders account for about 4.4% of sick leave claims.[8] Although no sick leave claims are filed in about two-thirds of registered cases,[9,10] the mean time lost was >70 days, which was higher than the mean of other causes.[11] Mean claim costs ranged from $5,000 to $8,000.[11] These data indicate that the economic impact of CANS is huge. Nevertheless, and in contrast to low back problems, only 2 prospective observational studies of prognostic indicators for the outcome of CANS in primary care are available.[12–15] Some prognostic studies have been published for subgroups of CANS, specifically, neck complaints (reviews of 6 studies in the general population and 7 studies in working populations[8,9] and 1 additional study[16]), shoulder complaints (reviews of 3 studies within a broader review[17] and 1 additional study[18,19]), and shoulder-arm-hand complaints (1 study[20]). Reasons for the low number of prognostic studies of CANS may be the different diagnostic labels applied (eg, repetitive strain injury, cumulative trauma disorders) and the various classifications used, together with a lack of clear definitions.[21–23] To improve the terminology regarding CANS, in 2004, a multidisciplinary consensus was reached in the Netherlands on a classification system, called the CANS model.[24] Huisstede et al defined CANS as "musculoskeletal complaints of the arm, neck, and shoulder not caused by acute trauma or systemic disease."[24(p316)] This model makes a distinction between specific and nonspecific disorders, and an overview is given of all specific disorders that can be included under this definition (eTab. 1, available at ptjournal.apta.org). If no specific condition is diagnosed, the condition should be classified as nonspecific CANS. In Dutch primary care, the ratio between specific and nonspecific disorders was estimated at 3:2.[25] Thereafter, a multidisciplinary guideline for diagnosis and treatment of nonspecific CANS was developed and approved by the participating professional organizations and patient association.[26,27] In the reviews performed for this guideline, the paucity of prognostic studies became apparent. This paucity led to recommendations for further research on prognostic factors (particularly psychological and social) and the way in which they can be identified and managed in primary care.

The aims of the present study were: (1) to analyze the course of disability over 2 years in patients with CANS in primary care and (2) to identify the prognostic factors for disability. Similar to prognostic factors for the course of low back complaints, we hypothesized that a multifactorial biopsychosocial model can explain much of the variance in the course of disabilities due to CANS.[28] This hypothesis means that personal, clinical, physical, and psychosocial characteristics need to be examined as potential prognostic indicators.

Method

Design and Setting

We conducted a prospective cohort study in 21 general practices in the southwest region of the Netherlands (Rotterdam and surroundings), with a 2-year follow-up. From September 2001 through December 2002, 36 general practitioners (GPs) recruited patients who consulted them for a new episode of CANS. Data were collected by means of 5 self-administered questionnaires at baseline and every 6 months thereafter during follow-up. Each participant provided written informed consent. Additional information on the procedure, follow-up regarding nonrecovery of complaints, and management of this cohort within the first 6 months is published elsewhere.[12,29] The study was observational, so the GPs provided care as usual without implementation or promotion of any diagnostic or therapeutic interventions. The present study analyzed the trajectories for the outcome of disability over a follow-up period of 2 years. The STROBE checklist was utilized to prepare this report.[30]

Participants

Patients were aged 18 to 64 years and able to complete questionnaires in Dutch. The episode of CANS was considered new if they had not visited their GP for the same complaint during the preceding 6 months. Patients were excluded when complaints were directly related to a preceding accident or fracture, malignancy, amputation, prosthesis, or congenital defect or to a previously diagnosed systemic disorder or generalized neurological disorder.

Outcome Measures

Disability was measured with the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire, containing 30 questions scored on a 5-point Likert-scale.[31–33] The sum of these scores was transferred to a 0 to 100 scale (with 100 indicating maximum disability). In addition to the DASH, patients could indicate their level of recovery in 7 response categories: "complete recovery," "much improved," "slightly improved," "same as before," "slightly deteriorated," "much deteriorated," and "worse than ever." Furthermore, patients could indicate the number of body regions associated with persistent symptoms based on the following responses: "no longer any complaints," "1 region," "2 regions," and "3 regions or more."

Prognostic Indicators

In the present study, potential prognostic indicators of disability over the course of 2 years were based on current biopsychosocial models of musculoskeletal pain.[28] The same prognostic indicators were studied as were reported previously with regard to recovery at 6 months[12] and are summarized below.

Demographic and participation characteristics. The demographic and participation characteristics studied were: (1) age, (2) sex, (3) educational level (low=no/primary/lower vocational education, medium=secondary/medium vocational education, and high=higher vocational education/university), (4) paid work (affirmative answer to the question "Are you currently employed or self-employed?"), and (5) sports participation ≥1 hour per week (yes/no).

Complaint characteristics. The complaint characteristics studied were: (1) location of main complaint (all locations with complaints were indicated on a mannequin, and 3 regions were designated: neck-shoulder [including upper back and upper arm], elbow-forearm, and wrist-hand; in case of the presence of multiple locations, patients indicated one region with the most complaints; if not indicated, the neck-shoulder-region [if present] was chosen as the region with most complaints; otherwise, the hand-wrist region was chosen); (2) widespread complaints in neck-shoulder, elbow-forearm, and hand-wrist regions, defined as presence of symptoms in all 3 regions; (3) based on the CANS model, the GP diagnosis was dichotomized as specific or nonspecific[24,29] (eTab. 2, available at ptjournal.apta.org, lists specific diagnoses); (4) complaint severity during week before baseline (11-point numeric rating scale); (5) duration of complaints at baseline (<6 weeks, 6 weeks to 3 months, and >3 months; based on the division in acute, subacute, and chronic that is common in low back pain[34]); and (6) new or recurrent complaint (in case of recurrence, the GP reported prior complaints, but not in the 6 months preceding the current episode).

Physical characteristics. The physical characteristics studied were: (1) general health, as measured with the 12-Item Short-Form Health Survey (SF-12) (answer to the first question recoded as "good" ["excellent"/"very good"/"good"] or "poor" ["fair"/"poor"]); the Physical Component Scale (PCS) and Mental Component Scale (MCS) were calculated based on a scale of 0 to 100, with higher scores indicating better health, recoded as <median=high limitations[35]; (2) history of trauma of neck or upper extremity (yes/no); (3) musculoskeletal comorbidity (positive response to a question on present chronic low back pain [>3 months]), osteoarthritis of the hip or knee, or other disorders in the arm-neck-shoulder region; (4) nonmusculoskeletal comorbidity (positive response to a question on the presence of nonmusculoskeletal disorders, such as intermittent claudication, cardiovascular disease, diabetes [types 1 and 2], neurological disorders, or other chronic disease [open question]); and (5) body mass index (self-reported weight and height^2; recoded as <25 kg/m^2=normal, 25–30 kg/m^2=overweight, and >30 kg/m^2=obese).

Psychosocial characteristics. The psychological characteristics studied were: (1) somatization and distress, as measured with subscales of the Four-Dimensional Symptom Questionnaire (4DSQ) (recoded as 0–10=low, 11–20=medium, and 21–32=high)[36]; (2) social support, as measured with the Dutch version of the Social Support Questionnaire (SSQ) (recoded as <median=low)[37]; (3) catastrophizing, as measured with the subscale of the Dutch version of the Coping Strategy Questionnaire (CSQ-catastrophizing) (recoded as >median=high)[38]; (4) health locus of control, as assessed with the question "Do you believe you can influence your health through your behavior?" and scored on a 4-point Likert scale (scores "considerable"/"to a large extent" recoded as "yes"); and (5) kinesiophobia, as measured with 13-item version of the Tampa Scale for Kinesiophobia (TSK) (without 4 reversed items; recoded as <23=low, 23–27=medium, and >27=high).[39]

Work characteristics. The work characteristics studied were: (1) sick leave due to CANS, as measured with the question "Were you absent from work in the past 6 months due to CANS?" (yes/no)[40]; (2) perceived work-relatedness, as measured by confirmative response to 1 of 3 questions: "Do the complaints return or worsen during the activities at work?", "Have you adapted or reduced your activities at work because of your complaints?", and "Do the complaints diminish after several days off work?"; (3) physical load at work, as measured with the short version of the Dutch Musculoskeletal Questionnaire (Physical Workload Questionnaire), with sum scores calculated for "heavy physical workload" and "long-lasting postures and repetitive movements"[41]; and (4) psychosocial factors at work, as measured with the Dutch version of the Job Content Questionnaire (high job strain derived from combination of high demands [above sample median] with low control [below sample median], being the weighted sum of decision authority and skill discretion).[42]

Data Analysis

For all follow-up measurements, the proportion of nonresponders was calculated and a non-response analysis was performed using multiple logistic regression. Furthermore, the proportion of patients with at least 2 completed follow-up questionnaires and with complete follow-up (4 questionnaires) was calculated. The total follow-up time was defined as the sum of the respondents who completed a follow-up questionnaire at any of the 4 follow-up measurements multiplied by the follow-up time of 0.5 years. The mean response was the sum of the responses at the follow-up measurements divided by 4.

Data analysis consisted of 2 steps. First, latent class growth mixture (LCGM) modeling was used to identify clinically meaningful groups of patients who were similar in their disability trajectory during the 2-year follow-up.[43–45] The LCGM analysis provides expectation-maximation estimates for assumed randomly missing data during follow-up. Each trajectory is called a "class" and follows a similar course during follow-up, which is represented by several parameters (eg, intercept, slope), accounting for within-class variation.[46] The LCGM model is built stepwise, starting with investigating several linear LCGM models, with pooled intercept and slope variance, for 1 to 5 classes. Next, quadratic and cubic models are explored, allowing for possible nonlinear developmental patterns. Then, a first choice is made between these models based on a combination of the following criteria: (1) indexes of fit (ie, Bayesian Information Criteria, Vuong-Lo-Mendell-Rubin likelihood ratio test, and bootstrap likelihood ratio test); (2) posterior probabilities: assignment of cases to the classes representing disability trajectories is checked to evaluate the distinction between the classes and the number of cases per class[44,45,47]; and (3) interpretability of the model: the trajectories are evaluated for their difference in course over time and possible clinical meaning for the groups of patients they represent. The most parsimonious model is preferred in case of very small differences between the criteria for 2 models and similar possible interpretation of the trajectories.[47] After this first choice, a further exploration is made, comparing models with pooled variance of intercept and slope with models with fixed variance set to zero and fixed variance set to the estimate of variance that is calculated in the model with pooled variance. Finally, based on the same criteria, a choice is made for the final model. Details of the different models are provided in eTable 3 (available at ptjournal.apta.org).

Second, univariate and multivariate multinomial logistic regression analyses were used to explore characteristics of the classes and the association with potential prognostic indicators at baseline (expressed as odds ratio [OR]). For continuous and ordinal variables, the linearity of their relationship with the classes and distribution was examined. In case of a linear relationship and a distribution that did not deviate from normality (Shapiro-Wilk statistic $>$0.95 at $P<.001$), the indicator was included as a continuous variable. In case of lack of linearity or a skewed distribution and absence of a clinically relevant categorization, the scores of a variable were split based on the median of the total population at baseline. For the Tampa scale, a split in tertiles resulted in a better performance of the resulting model. Because the clinical use of 3 categories per subscale is recommended for the 4DSQ, we used this categorization for the variables of somatization and distress.[36,48]

Variables showing a significant association ($P<.05$) with one or more trajectories in the univariate analysis were selected for multivariate multinomial regression analysis, after a check for possible multicollinearity (in which case, the variable with the highest association is retained for further analyses). Because of their clinical relevance, an a priori decision was made to select the variables of age, sex, region with most complaints, and specific/nonspecific diagnosis independently from a significant association. A backward-step procedure (Wald) was performed to include only those variables that made a significant contribution to the model ($P<.05$). The proportions of explained variance (Nagelkerke R^2) and correctly predicted cases were calculated to give an indication of the fit of the final model.

We used M*plus* version 6.1 (Muthén & Muthén, Los Angeles, California) for LCGM modeling. Nonresponse analysis, description of the course of disability, analysis of the characteristics of class membership, and various multinomial and linear regression analyses (including normality and collinearity diagnostics) were performed using IBM SPSS software, version 22 (IBM Corp, Armonk, New York).

Role of the Funding Source

This study was supported by internal funding from Erasmus University Medical Center, Rotterdam, and the Rotterdam University of Applied Sciences.

Results

Sample Characteristics

A total of 798 patients who consulted their GP for a new episode of CANS fulfilled the criteria to enter this 2-year prospective cohort study and were asked to participate. Of these patients, 682 (85.5%) (mean age=44.3 years, 42% male) participated. Twenty-eight percent of the participants had a higher education level, and 36% had a medium education level. Seventy-eight percent of the participants had paid work. Table 1 lists the responses at the follow-up measurements. Of all participants, 86% completed 2 to 4 follow-up questionnaires, and 69% had a complete follow-up of 4 questionnaires. Total follow-up time was 1,125 person-years; the mean response was 82.5%. In general, differences between responders and nonresponders were small. The chance of nonresponse was higher for men (at 2 follow-up measurements) and rose slightly with age of the participants (at all follow-up measurements).

Disability Trajectories

Table 2 presents the DASH scores and recovery rates at baseline and follow-up. In the first 6 months after baseline, there was considerable improvement in the mean DASH score and in the proportion of respondents indicating a "normal" DASH score (ie, $<$11),[49,50] absence of complaints, or complete recovery or much improvement. However, during the 2-year follow-up, 40% to 45% of the patients did not indicate complete recovery or much improvement, and an even larger group reported persisting complaints.

The characteristics of the LCGM models are listed in eTable 3. Based on fit criteria, posterior probabilities of the classes, clinical relevance, number of cases in the smallest trajectory, and parsimoniousness of the model, a 3-class linear model was preferred. The 3-class model with fixed variance for the intercept and slope at the level of the estimates for variance in the model with pooled variance fitted much better and was chosen as the final model. Figure 1 shows the 3 trajectories for disability in this model.

From a clinical standpoint, we interpret class 1 as the fast recovery group (67.6% of the total, 94% correctly assigned), class 2 as the modest recovery group (23.6% of the total, 86% correctly assigned), and class 3 as the continuous high disability group (8.8% of the total, 91% correctly assigned). Class 3 included

Table 1.
Determinants of Nonresponse at the 4 Follow-up Measurements[a]

Variable	6 mo	12 mo	18 mo	24 mo
No. (%) of respondents	612 (89.7%)	568 (83.3%)	536 (78.6%)	534 (78.3%)
Participants with missing follow-up questionnaires (none missing: 68.9%)	1 missing (10.7%)	2 missing (6.6%)	3 missing (8.7%)	4 missing (5.1%)
Association with response, OR (95% CI)				
Age	1.03 (1.00, 1.05)	1.03 (1.01, 1.05)	1.06 (1.04, 1.08)	1.04 (1.02, 1.05)
Male	1.73 (1.04, 2.87)		1.67 (1.11, 2.51)	
Educational level, n (%)				
Low			0.47 (0.28, 0.80)	
Medium			0.57 (0.35, 0.95)	
High			Reference	
No sports participation				0.63 (0.43, 0.92)
Having paid work			0.58 (0.34, 0.98)	
Low general health		1.81 (1.04, 3.15)		
Mental limitations, baseline (SF-12 MCS)				1.02 (1.00, 1.04)

[a] OR=odds ratio; CI=confidence interval; SF-12 MCS=12-Item Short-Form Health Survey Mental Component Scale; SF-12 PCS=12-Item Short-Form Health Survey Physical Component Scale; DASH=Disabilities of the Arm, Shoulder and Hand questionnaire; 4DSQ=Four-Dimensional Symptom Questionnaire. See Method section of text for measures that were utilized, included in the models education, body mass index, paid work, specific diagnosis, region of most complaints, widespread complaints (3 regions), recurrent complaint, complaint duration, complaint severity previous week, nonmusculoskeletal comorbidity, low general health, physical limitations (DASH and SF-12 PCS; not tested with DASH simultaneously due to high correlation; same other variables in model), somatization and distress (4DSQ), mental limitations (SF-12 MCS; not tested with 4DSQ distress scale simultaneously due to high correlation; same other variables in model), high kinesiophobia, high catastrophizing, low social support, and low health locus of control.

patients with a constantly high DASH score and patients with fluctuating scores at relatively high levels. Patients in class 2 showed a decrease in DASH scores during the first 6 months after baseline and thereafter, on average, continued disability. Patients in class 1 showed a larger decrease in DASH than patients in class 2 and, on average, continued disability at a much lower level. Both classes included patients with a relatively constant magnitude of disability and patients with highly fluctuating disability (Fig. 2).

Characteristics of the 3 Trajectories

Table 3 presents the characteristics of the disability trajectories and the results of the univariate multinomial regression analyses. All variables, except for specific diagnosis, region with most complaints, and low health locus of control, were associated with continuous high disability. All variables, except for specific diagnosis, region with most complaints, body mass index, and history of trauma, were associated with modest recovery. Highest ORs, especially in relation to continuous high disability, were found for the psychosocial variables of somatization, distress, and kinesiophobia; the complaint characteristics of duration at baseline and widespread complaints; and the physical characteristics of poor general health, musculoskeletal comorbidity, and physical limitations at baseline measured with the DASH or SF-12 PCS.

Patients with paid work had a higher likelihood to show fast recovery. Of those with paid work, high static or repetitive load, self-perception of work-relatedness, and sick leave in the 6 months before or at baseline were associated with continuous high disability. These same variables, as well as the variables of full-time work, low coworker support, high job strain, and low skill discretion, showed an association with modest recovery (eTab. 4, available at ptjournal.apta.org). These factors coun-

Table 2.
Level of Disability Due to CANS at Baseline and Follow-up[a]

Variable	Baseline	6 mo	12 mo	18 mo	24 mo
DASH score					
$\overline{X}$	36.8	18.8	17.0	18.3	15.9
SD	18.8	18.2	18.9	19.7	19.9
Median	35.3	14.7	10.1	11.2	7.8
Range	2.6–99.1	0–80.2	0–83.6	1.7–92.2	0–98.3
Proportion with DASH score <11	5.9%	44.0%	51.1%	49.1%	57.7%
No longer any complaints	0%	36.9%	42.1%	47.7%	42.9%
Complete recovery/much improved	0%	54.3%	56.2%	60.2%	61.5%

[a] CANS=complaints of arm, neck, and shoulder; DASH=Disabilities of the Arm, Shoulder and Hand questionnaire.

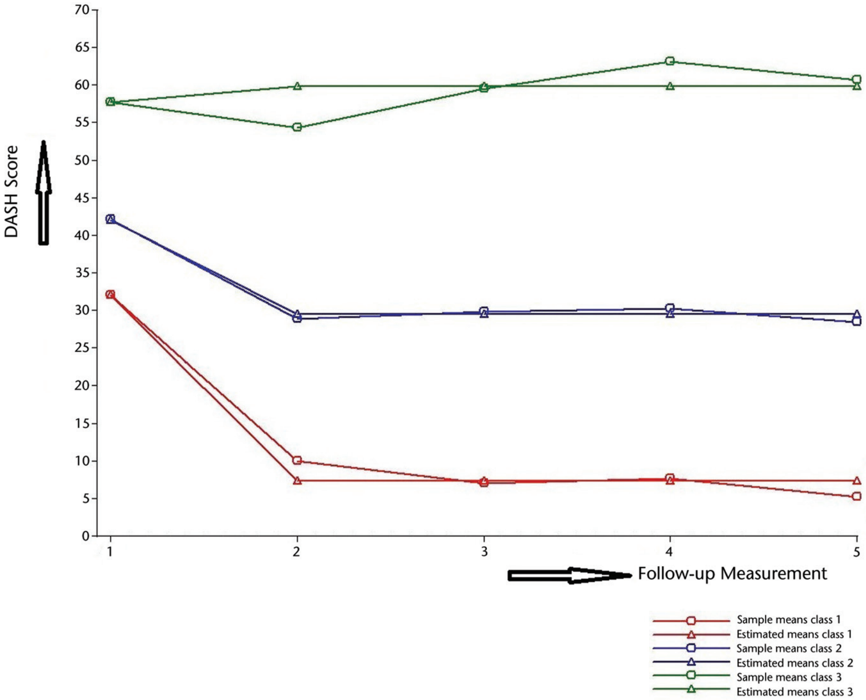

Figure 1.
Three disability trajectories in patients with complaints of the arm, neck, and shoulder (CANS) in primary care. DASH=Disabilities of the Arm, Shoulder and Hand questionnaire.

teracted the relative advantage of paid work at the general population level.

Table 4 presents the multivariate model that summarizes the simultaneous associations of predictors at baseline with the trajectories, using a backward-step procedure (Wald test). All variables showing an association with one or more trajectories in the univariate analysis (Tab. 3) were entered in the analysis. The variables of specific diagnosis and region with most complaints also were entered in the analysis because of their clinical relevance. Of the work-related variables, only the variable of having paid work was included because, at the general population level, there were no univariate associations with the trajectories. Because the trajectories are directly related to disabilities, the DASH and SF-12 PCS scores were not included in the model. The SF-12 MCS scores also were not included because of their high correlation with distress (4DSQ). All other variables had no correlations or low correlations. The calculated proportion of explained variance (Nagelkerke R^2) of the final model was 0.54, which indicates a good fit to the data.

The model showed that >3 months' complaint duration and a high level of somatization were the most important baseline predictors of the continuous high disability trajectory, followed by musculoskeletal comorbidity, poor general health, history of trauma, widespread complaints, low social support, female sex, low educational level, high complaint severity, and a medium level of somatization. The indicators >3 months complaint duration, musculoskeletal comorbidity, female sex, history of trauma, low educational level, low social support, and high complaint severity also showed an association with the modest recovery trajectory. Age, kinesiophobia, and catastrophizing showed only a significant association with modest recovery. However, for a high level of kinesiophobia, the OR for the association with high disability was within the 95% confidence interval (CI) of the association with modest recovery, so this lack of significance can be explained by the low number of cases in this class. Distress was not associated with any trajectory.

A more parsimonious model, explaining already 46% of the variance, would include half the number of prognostic indicators: age, sex, duration and severity of complaints, musculoskeletal comorbidity, somatization, and kinesiophobia (eTab. 5, available at ptjournal.apta.org).

Discussion

Main Results

To our knowledge, this is the first prospective cohort study of patients in primary care with a new episode of CANS in which disability trajectories were analyzed over a 2-year period, together with their prognostic indicators. This cohort can be regarded as representative for Dutch patients with CANS because the numbers of participating practices and GPs were large enough to account for possible local variations in patient groups, the initial response to participate was very high, and relatively low non-response rates at follow-up were observed. There were no indications that patients with CANS in the southwest region of the Netherlands differ much from those of other regions.

Three disability trajectories were differentiated: fast recovery (67.6%), modest recovery (23.6%), and continuous high disability (8.8%). The proportion of patients with DASH scores comparable to those of the normal population (<11)[49,50] increased from 44% at 6-month follow-up to 58% at 2-year follow-up. A slightly higher proportion (54%–62%) indicated complete recovery or much improvement at all follow-up measurements. However, only 43% of the patients indicated absence of complaints at 2-year follow-up.

The fast recovery trajectory represents the majority of patients who had an improved outcome at 2-year follow-up (most already at 6 months after baseline); in this group, the number of recurrences was low. The modest recovery trajectory consists of patients with persisting disability at a lower level compared with baseline, as well as patients with relapses and recurrent disabilities after initial improvement. This conclusion is supported by the fact that, at all follow-up measurements, the proportion of patients without complete recovery or much improvement (46%–38%) or a nor-

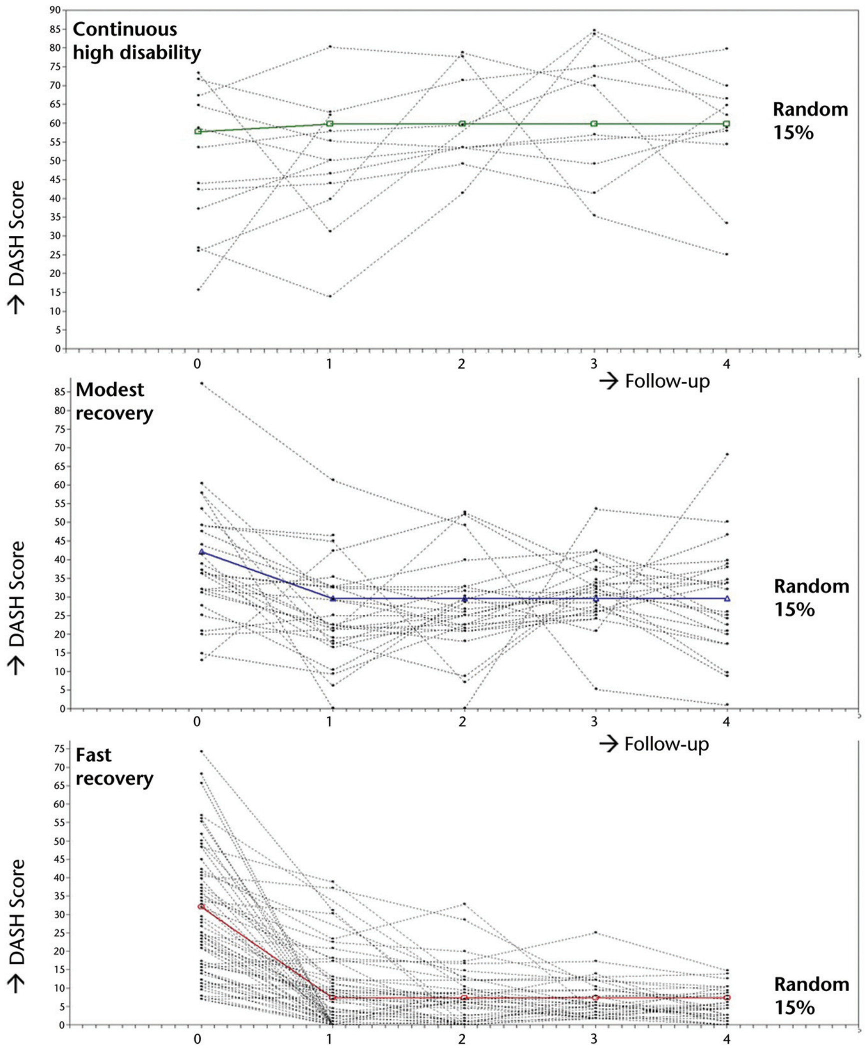

Figure 2.

Observed variability within each trajectory in a 15% random sample. DASH=Disabilities of the Arm, Shoulder and Hand questionnaire.

mal level of disability (56%–42%) was considerably higher than the proportion of patients in the high disability trajectory (8.8%). Therefore, many of these patients must be in the modest recovery trajectory.

We present several demographical, complaint-related, physical, and psychosocial characteristics that have predictive value for the high disability and modest recovery trajectories. These characteristics can be identified using screening methods that capture information obtained through patient history and administering validated measures, such as the 4DSQ and Tampa scale. This approach implies the feasibility for clinicians to differentiate subgroups of patients within the larger group with nonspecific complaints who might have a different prognosis based on appropriate adaptation of therapeutic management focusing on the identified predictors. This option for differentiation is especially relevant for physical therapists because the GPs referred 63% of all patients to physical therapists during the 2-year follow-up. However, the exact performance of these predictive variables in this subgroup still has to be studied.

Limitations

The present study had some limitations. First, at the different follow-up measurements, loss to follow-up ranged from 10% to 22% of the cohort, and no follow-up data were available for 5% of the initial cohort. Nevertheless, for a follow-up study with a large initial cohort, these data are very acceptable.[51] Furthermore, the LCGM analysis provides estimates for missing data during follow-up, and the nonresponse analysis yielded only small differences. Overall, of the prognostic indicators present in the final models, the responders are slightly less likely to be of older age or male.

Second, a patient-reported outcome measure (DASH) was used to assess disabilities, and no physical tests were performed. However, the DASH is a widely used and well-validated measure for CANS, both in total and at specific body regions.[31,33,49]

Third, the GPs' diagnosis at the first consultation was used to differentiate between specific CANS (59%) and nonspecific CANS (41%). However, as the CANS model had not yet been published and no classification criteria were available at that time, some misclassification may have occurred. In our analysis, a specific diagnosis is not associated with any trajectory. However, optimal classification may slightly alter this association.

Fourth, some predictor variables were assessed with measures or questions with limited or unknown validity, such as history of trauma of neck or upper extremity, musculoskeletal or nonmusculoskeletal comorbidity, health locus of control, social support, and catastrophizing. This limitation might have influenced their association with the disability trajectories.

Fifth, the presented model has less explained variance (0.544) than a full model including all variables of Table 3 (0.574) or a model resulting from using a backward step procedure with $P<.157$ (0.552). In the latter model, the only difference is the inclusion of the not significantly associated variable of region with most complaints. A more parsimonious model including half the number of prog-

Table 3.
Characteristics of the Disability Trajectories and Results of Univariate Multinomial Regression Analysis[a]

Variable	Characteristics			OR (95% CI)	
	Fast Recovery (n=461)	Modest Recovery (n=161)	Continuous High Disability (n=60)	Modest Recovery	Continuous High Disability
Demographical and participation characteristics					
Age (y), $\overline{X}$ (SD)	42.8 (11.3)	47.7 (11.6)	47.2 (9.9)	1.04 (1.02, 1.06)	1.04 (1.01, 1.06)
Female, n (%)	238 (51.6)	114 (70.8)	47 (78.3)	2.27 (1.55, 3.34)	3.39 (1.79, 6.43)
Educational level, n (%)[b]					
Low	137 (29.8)	77 (47.8)	30 (50.0)	2.69 (1.68, 4.31)	3.72 (1.71, 8.12)
Medium	170 (37.0)	52 (32.3)	21 (35.0)	1.46 (0.90, 2.39)	2.10 (0.93, 4.73)
High	153 (33.3)	32 (19.9)	9 (15.0)	Reference	Reference
No sports participation, n (%)	232 (50.3)	106 (65.8)	42 (70.0)	1.90 (1.31, 2.76)	2.30 (1.29, 4.12)
Having paid work, n (%)[c]	382 (82.9)	114 (70.8)	38 (63.3)	0.50 (0.33, 0.76)	0.36 (0.20, 0.64)
Complaint characteristics					
Specific diagnosis (vs nonspecific), n (%)	271 (58.9)	89 (55.3)	42 (70.0)	0.86 (0.60, 1.24)	1.63 (0.91, 2.91)
Region with most complaints,[d] n (%)					
Neck or upper back or shoulder or upper arm	303 (65.7)	120 (74.5)	34 (56.7)	Reference	Reference
Elbow or forearm	98 (21.3)	25 (15.5)	16 (26.7)	0.64 (0.40, 1.05)	1.46 (0.77, 2.75)
Wrist or hand	60 (13.0)	16 (9.9)	10 (16.7)	0.67 (0.37, 1.22)	1.49 (0.70, 3.17)
Widespread complaints (in all 3 regions), n (%)	70 (15.2)	42 (26.1)	34 (56.7)	1.79 (1.28, 3.04)	7.30 (4.13, 12.92)
Recurrent complaint, n (%)	99 (21.5)	67 (41.6)	25 (41.7)	2.61 (1.78–3.83)	2.61 (1.49, 4.57)
High complaint severity last week (NRS), $\overline{X}$ (SD)[c]	5.5 (2.0)	6.1 (1.8)	7.2 (1.7)	1.16 (1.06, 1.28)	1.69 (1.42, 2.02)
Duration of complaint, n (%)[b]					
0–6 wk	269 (58.5)	61 (37.9)	14 (23.3)	Reference	Reference
6 wk–3 mo	115 (25.0)	37 (23.0)	10 (16.7)	1.42 (0.89, 2.26)	1.67 (0.72, 3.87)
>3 mo	76 (16.5)	63 (39.1)	36 (60.0)	3.66 (2.37, 5.65)	9.10 (4.67, 17.75)
Physical characteristics					
History of trauma of arm, neck, or shoulder, n (%)	71 (15.4)	32 (19.9)	22 (36.7)	1.36 (0.86, 2.16)	3.18 (1.78, 5.70)
Body mass index (kg/m^2), n (%)[c]					
<25	230 (50.0)	79 (49.1)	30 (50.0)	Reference	Reference
25–30 (overweight)	184 (40.0)	61 (37.9)	13 (21.7)	0.97 (0.66, 1.42)	0.54 (0.28, 1.07)
>30 (obese)	46 (10.0)	21 (13.0)	17 (28.3)	1.33 (0.75, 2.36)	2.83 (1.44, 5.56)
Comorbidity, musculoskeletal, n (%)[b]	178 (38.6)	104 (64.6)	49 (81.7)	2.90 (2.00, 4.21)	7.08 (3.59, 13.98)
Comorbidity, nonmusculoskeletal, n (%)[b]	77 (16.7)	42 (26.1)	26 (43.3)	1.76 (1.15, 2.70)	3.81 (2.17, 6.72)
Poor general health (SF-12, 1st question), n (%)[b]	28 (6.1)	30 (18.6)	28 (46.7)	3.53 (2.04, 6.13)	13.50 (7.15, 25.48)
Physical limitations, baseline (SF-12 PCS), <45.0, n (%)	191 (42.0)	94 (59.1)	52 (86.7)	2.00 (1.39, 2.89)	8.98 (4.17, 19.35)
Physical limitations, baseline (DASH), >35.4, n (%)	169 (36.7)	102 (63.7)	56 (93.3)	3.04 (2.09, 4.42)	24.19 (8.62, 67.89)
$\overline{X}$ (SD)	32.1 (17.8)	41.8 (14.8)	59.3 (16.5)	1.03 (1.02, 1.04)	1.09 (1.07, 1.10)
Psychosocial characteristics					
Mental limitations, baseline (SF-12 MCS) <54.6, n (%)	207 (45.5)	87 (54.7)	43 (71.7)	1.45 (1.01, 2.08)	3.03 (1.68, 5.47)
Somatization (4DSQ), n (%)[b]					
Low (0–10)	387 (83.9)	99 (61.9)	17 (28.3)	Reference	Reference
Medium (11–20)	70 (15.2)	53 (33.1)	25 (41.7)	2.96 (1.95, 4.50)	8.13 (1.30, 15.39)
High (21–32)	4 (0.9)	8 (5.0)	18 (30.0)	7.82 (2.31, 26.49)	102.4 (31.2, 325.8)

(Continued)

Table 3.
Continued

Variable	Characteristics			OR (95% CI)	
	Fast Recovery (n=461)	Modest Recovery (n=161)	Continuous High Disability (n=60)	Modest Recovery	Continuous High Disability
Distress (4DSQ), n (%)[b]					
Low (0–10)	320 (69.6)	90 (55.9)	22 (36.7)	Reference	Reference
Medium (11–20)	111 (24.1)	46 (28.6)	13 (21.7)	1.47 (0.97, 2.23)	1.70 (0.83, 3.50)
High (21–32)	29 (6.3)	25 (15.5)	25 (41.7)	3.07 (1.71, 5.50)	12.54 (6.31, 24.94)
Low health locus of control, n (%)	174 (37.7)	76 (47.2)	30 (50.0)	1.48 (1.03, 2.12)	1.65 (0.96, 2.83)
Kinesiophobia (TSK), n (%)[e]					
Low (13–22)	203 (46.6)	47 (31.8)	9 (15.3)	Reference	Reference
Medium (22–27)	125 (28.7)	31 (20.9)	18 (30.5)	1.07 (0.65, 1.78)	3.25 (1.42, 7.45)
High (28–32)	108 (24.8)	70 (47.3)	32 (54.2)	2.80 (1.81, 4.33)	6.68 (3.08, 14.51)
High catastrophizing (CSQ-catastrophizing), >9, n (%)[f]	186 (40.5)	105 (65.2)	41 (68.3)	2.75 (1.89, 4.00)	3.17 (1.78, 5.63)
Low social support (SSQ), <7, n (%)[g]	196 (42.6)	100 (62.1)	46 (76.7)	2.21 (1.53, 3.19)	4.43 (2.37, 3.28)

[a] OR=odds ratio; CI=confidence interval; NRS=numeric rating scale; SF-12 MCS=12-Item Short-Form Health Survey Mental Component Scale; SF-12 PCS=12-Item Short-Form Health Survey Physical Component Scale; DASH=Disabilities of the Arm, Shoulder and Hand questionnaire; 4DSQ=Four-Dimensional Symptom Questionnaire; TSK=Tampa Scale for Kinesiophobia; CSQ-catastrophizing=Coping Strategy Questionnaire catastrophizing subscale; SSQ=Social Support Questionnaire. See Method section of text for measures that were utilized. Fast recovery group is reference group for multinomial regression analysis. Cutoff points for dichotomous variables are defined by median score of the total population.
[b] 1 missing questionnaire.
[c] 2 missing questionnaires.
[d] In 12 cases with complaints at multiple locations without most painful location, neck-shoulder-forearm was chosen if present; otherwise, hand-wrist was chosen.
[e] 4 missing questionnaires.
[f] 5 missing questionnaires.
[g] 22 missing questionnaires.

nostic indicators would explain already 46% of the variance.

Finally, although LCGM is a well-established method to analyze distinct trajectories, the decision regarding the optimal number of classes and the use of a model with pooled or fixed variance remains to some extent arbitrary[52]; however, the number of cases and allocation to the respective trajectories proved to be good. The advantage of LCGM is that the course of CANS can be examined over time; moreover, especially the category of patients with continuous high disability can be identified, resulting in an analysis of the prognostic indicators for this specific trajectory.

Prognostic Indicators Compared With Other Studies

The present study is unique in its description of disability trajectories for the whole group of patients with CANS and the analysis of prognostic indicators of disability. All other studies reviewed used a single endpoint of recovery after one specific follow-up period (generally between 6 months and 5 years). Also, most earlier studies investigated only one region, mostly the neck or shoulder (eTab. 6, available at ptjournal.apta.org).

With regard to psychosocial characteristics, somatization was identified as an important prognostic indicator for continuous high disability, as also described for the CANS cohort in a physical therapy setting.[14–16] Only one other primary care study[18] also looked at the predictive value of somatization in shoulder disorders but showed no association with persistent shoulder symptoms (46% of the initial group at 6-month follow-up, although there was an association in their univariate analysis). Our results show a significant association of somatization with the high disability trajectory and a trend of association with modest recovery. Earlier, in both CANS cohorts, an association of "high catastrophizing" and "high kinesiophobia" with unfavorable outcome was shown at some follow-up measurements, especially in nonspecific disorders.[13–15] This association was confirmed in the present study. Previously, an association with catastrophizing was found in relation to recovery of chronic shoulder complaints[19] and neck complaints.[16] With regard to kinesiophobia, earlier studies showed no association with recovery in patients with neck complaints[16,53,54] or shoulder complaints.[18] In our cohort, we also identified low social support as a prognostic indicator for both trajectories with worse outcome, whereas other authors found no such association.[14–16,54] The variable of distress was investigated in both CANS cohorts (and a subgroup with neck pain) and in several cohorts with shoulder disorders; however, no association with outcome was observed.[16–18] Also, in both CANS cohorts, no association with general mental limitations or low health locus of control was found.[12,14,15]

Table 4.
Multivariate Multinomial Regression Analysis for Characteristics of Disability Trajectories[a]

Variable	Disability Class	
	Modest Recovery OR (95% CI)	Continuous High Disability OR (95% CI)
Demographical and participation characteristics		
Age (y)	1.06 (1.04, 1.09)	1.03 (0.99, 1.07)
Female	2.83 (1.70, 4.72)	3.18 (1.28, 7.91)
Educational level		
Low	2.23 (1.22, 4.07)	3.13 (1.02, 9.59)
Medium	1.16 (0.63, 2.12)	1.61 (0.52, 4.96)
High	Reference	Reference
Complaint characteristics		
Specific diagnosis (vs nonspecific)	0.73 (0.45, 1.18)	2.08 (0.89, 4.84)
Widespread complaints (in all 3 regions)	1.14 (0.64, 2.06)	3.99 (1.68, 9.49)
High complaint severity previous week	1.14 (1.01, 1.30)	1.62 (1.28, 2.06)
Duration of complaint		
0–6 wk	Reference	Reference
6 wk–3 mo	1.76 (0.98, 3.14)	1.85 (0.61, 5.64)
>3 mo	4.48 (2.57, 7.79)	11.17 (4.38, 28.47)
Physical characteristics		
History of trauma arm, neck, or shoulder	2.35 (1.26, 4.37)	4.27 (1.63, 11.17)
Poor general health (SF-12, 1st question)	1.40 (0.69, 2.85)	4.79 (1.84, 12.44)
Comorbidity, musculoskeletal	2.87 (1.79, 4.61)	4.92 (1.91, 12.66)
Psychosocial characteristics		
Somatization (4DSQ)		
Low	Reference	Reference
Medium	1.65 (0.97, 2.80)	2.47 (1.04, 5.91)
High	3.04 (0.66, 14.00)	10.03 (1.88, 53.61)
Kinesiophobia (TSK)		
Low	Reference	Reference
Medium	0.96 (0.52, 1.75)	2.44 (0.81, 7.35)
High	2.05 (1.16, 3.61)	2.63 (0.87, 7.93)
High catastrophizing (CSQ-catastrophizing)	2.25 (1.36, 3.73)	1.28 (0.52, 3.13)
Low social support (SSQ)	1.72 (1.08, 2.76)	3.92 (1.65, 9.32)
Intercept	−7.77	−13.17

[a] OR=odds ratio; CI=confidence interval; SF-12=12-Item Short-Form Health Survey; 4DSQ=Four-Dimensional Symptom Questionnaire; TSK=Tampa Scale for Kinesiophobia; CSQ-catastrophizing=Coping Strategy Questionnaire catastrophizing scale; SSQ=Social Support Questionnaire. Explained variance (Nagelkerke R^2=0.544). Percentage correctly predicted overall: 76.8% (91.5% within fast recovery group, 42.2% within modest recovery group, and 55.9% within continuous high disability group). See Method section of text for measures that were utilized. Model without SF-12 Mental Component Scale because of the high correlation (.67) with distress score (4DSQ). Fast recovery group is reference group for multinomial regression analysis. Cutoff points for dichotomous variables are defined by median score of the total population. The variables of paid work, no sports participation, recurrent complaints, nonmusculoskeletal comorbidity, low health locus of control, and distress (4DSQ) were removed from the model.

With regard to physical characteristics, our study shows that musculoskeletal comorbidity is an important prognostic indicator, which is in line with other studies.[17,18,53,55,56] Poor self-perceived general health is consistently related to unfavorable outcome.[53,55] A history of trauma or injury in the region of complaints was associated with unfavorable outcome in some studies[53,55] and in our study, but not in other studies.[14–16,57] Depending on the interpretation of "trauma" or "injury" and the formulation of the question, preceding trauma can be indicated occasionally by respondents who experience (for instance) bumping, pulling, or arm strain. However, such a history is difficult to link to the complaints under study when patients with diagnoses indicating a traumatic cause (eg, contusion, distortion, whiplash) have been excluded. For nonmusculoskeletal comorbidity, the evidence is inconclusive; however, there is much variation in the applied definitions. Also, evidence for an association of physical limitations at baseline with unfavorable outcome is inconclusive. In the present study, because the outcome of interest was disability, the baseline value was not included in the analysis.

Within the group of complaint characteristics, >3 months complaint duration at baseline was identified as a prognostic indicator, which is similar to other studies.[15–18,20,55,56,58] Furthermore, we identified complaints that are widespread over the arm-neck-shoulder region as a prognostic indicator. However, the main location of the complaints or having a specific diagnosis was not associated with any disability trajectory; this finding is similar to the earlier CANS cohort.[14,15] In the present study (and in other studies[17–20,55]), high complaint severity or pain intensity at baseline was associated with unfavorable outcome. However, this association was not present at 6-month follow-up in our cohort, at 2-year follow-up in the earlier CANS cohort,[12,15] or in 3 studies on neck complaints.[16,53,56] For recurrent complaints as a possible prognostic indicator, the evidence is inconsistent. In the present study, we found no association with any disability trajectory.

Examining the demographical and participation characteristics revealed that female sex and low educational level were associated with both disability trajectories. Older age was associated with only the modest recovery trajectory; however, the associations with both disability trajectories might be underestimated due to the fact that nonresponse was higher among older people. Although results for these variables vary among different studies, the absence of an association is consistent for shoulder disorders.[17–20] Regarding sports participation, no association with any disability trajectory or recovery was present in the 2 CANS cohorts. This finding confirms the results of other studies in which physical exercise or activity at baseline was included as a possible prognostic indicator.[14,15,18,19,55]

With regard to unemployment, we previously found an association with nonrecovery at 6 months follow-up.[12] However, in the present study, a relationship between unemployment and both disability trajectories was found only in the univariate analysis. In other studies in which unemployment was included as a possible prognostic indicator, no association was found with unfavorable outcome.[14,15,20,53,55,58]

In conclusion, this study revealed 3 trajectories that describe the course of disabilities due to CANS over a 2-year follow-up: fast recovery, modest recovery, and continuous high disability. We identified several sociodemographic, complaint-related, physical, and psychosocial prognostic indicators that can easily be recognized in a primary care setting. It is important to identify patients at risk for continuous high disability at an early disease stage. Some prognostic indicators related to this particular outcome may be amenable for change (eg, the psychosocial factors of somatization, kinesiophobia, and catastrophizing and the physical factors of poor general health and musculoskeletal comorbidity). Thus, in view of the considerable numbers of patients following a trajectory of chronic disabilities in CANS, establishing a clear prognosis can be valuable to mitigate this course. We recommend checking the indicators identified in this study at an early stage of CANS before giving advice about treatment options. The presence of these indicators may lead to a decision for more intensive or additional interventions. For psychosocial indicators, the involvement of a psychosomatic physical therapist or psychologist or a multidisciplinary approach can be considered, and, for physical indicators, more intensive therapy may be appropriate. A similar management approach in patients with nonspecific low back pain, using a screening method to identify patients at high risk for persistent disability and providing psychologically informed physical therapy, has already shown to have promising effects compared with usual management by physical therapists.[59–61] Further research focusing on the use of these prognostic indicators in treatment decision making is needed to further substantiate their predictive value and may result in a screening tool that can be applied in patients with CANS.

Dr Miedema, Dr Feleus, Professor Bierma-Zeinstra, Professor Burdorf, and Professor Koes were responsible for the initial idea to conduct a prospective cohort study in primary care in order to study the course and outcome of patients with CANS. Together they were responsible for the study design, choice of measures, and content of questionnaires. Dr Miedema is guarantor for the part of the study described in this article. Dr Feleus conducted data collection under the supervision of Professor Bierma-Zeinstra, Dr Miedema, and Professor Koes. Dr Feleus, Professor Bierma-Zeinstra, and Professor Koes were involved in organization of the network of GPs who participated in the study. Dr Miedema, Dr Feleus, Professor Burdorf, and Professor Koes were responsible for the planning of the analyses of the 2-year follow-up data. Dr Hoekstra was consulted for specific advice regarding use of LCGM and the M*plus* software. Dr Miedema and Dr Feleus constructed the design and syntaxes for the analyses using M*plus* and SPSS software. Dr Miedema performed all analyses for this study and drafted the manuscript. Dr Hoekstra was consulted about the output of M*plus* software and the choice of the final LCGM model. All authors were involved in discussions on the study results, commented on drafts of the manuscript, and approved the final version.

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References

1 Morse TF, Dillon C, Warren N, et al. The economic and social consequences of work-related musculoskeletal disorders: the Connecticut Upper-Extremity Surveillance Project (CUSP). *Int J Occup Environ Health*. 1998;4:209–216.

2 Huisstede BM, Wijnhoven HA, Bierma-Zeinstra SM, et al. Prevalence and characteristics of complaints of the arm, neck, and/or shoulder (CANS) in the open population. *Clin J Pain*. 2008;24:253–259.

3 Walker-Bone K, Palmer KT, Reading I, et al. Prevalence and impact of musculoskeletal disorders of the upper limb in the general population. *Arthritis Rheum*. 2004;51:642–651.

4 Urwin M, Symmons D, Allison T, et al. Estimating the burden of musculoskeletal disorders in the community: the comparative prevalence of symptoms at different anatomical sites, and the relation to social deprivation. *Ann Rheum Dis*. 1998;57:649–655.

5 Feleus A, Bierma-Zeinstra SM, Miedema HS, et al. Incidence of non-traumatic complaints of arm, neck and shoulder in general practice. *Man Ther*. 2008;13:426–433.

6 Klein Hesselink J, Hooftman W, de Weerd M, Koppes L. Ziekteverzuim in Nederland in 2009. Hoofddorp, the Netherlands: TNO; 2011. Available at: http://publications.tno.nl/publication/100861/IoQ0uu/kleinhesselink-2011-ziekteverzuim.pdf. Accessed October 26, 2014.

7 Blatter B, Houtman I, van den Bossche S, et al. Gezondheidsschade en kosten als gevolg van RSI en psychosociale arbeidsbelasting in Nederland. Hoofddorp, the Netherlands: TNO Kwaliteit van Leven; August 2005. Available at: http://docplayer.nl/383911-Gezondheidsschade-en-kosten-als-gevolg-van-rsi-en-psychosociale-arbeidsbelasting-in-nederland.html.

8 Feuerstein M, Miller VL, Burrell LM, Berger R. Occupational upper extremity disorders in the federal workforce: prevalence, health care expenditures, and patterns of work disability. *J Occup Environ Med*. 1998;40:546–555.

9 Hashemi L, Webster BS, Clancy EA, Courtney TK. Length of disability and cost of work-related musculoskeletal disorders of the upper extremity. *J Occup Environ Med*. 1998;40:261–269.

10 Silverstein B, Viikari-Juntura E, Kalat J. *Work-Related Musculoskeletal Disorders of the Neck, Back and Upper Extremity in Washington State 1990–1998*. Olympia, WA: Washington State Department of Labor and Industries; May 2000. Technical Report No. 40-4a-2000.

11 Baldwin ML, Butler RJ. Upper extremity disorders in the workplace: costs and outcomes beyond the first return to work. *J Occup Rehabil*. 2006;16:303–323.

12 Feleus A, Bierma-Zeinstra SM, Miedema HS, et al. Prognostic indicators for non-recovery of non-traumatic complaints at arm, neck and shoulder in general practice: 6 months follow-up. *Rheumatology (Oxford)*. 2007;46:169–176.

13 Keijsers E, Feleus A, Miedema HS, et al. Psychosocial factors predicted nonrecovery in both specific and nonspecific diagnoses at arm, neck, and shoulder. *J Clin Epidemiol*. 2010;63:1370–1379.

14 Karels CH, Bierma-Zeinstra SM, Burdorf A, et al. Social and psychological factors influenced the course of arm, neck and shoulder complaints. *J Clin Epidemiol*. 2007;60:839–848.

15 Karels CH. *Arm, Neck and Shoulder Complaints in Physical Therapy Practice: Course and Prognosis*. Rotterdam, the Netherlands: Erasmus University Medical Center; 2009.

16 Verhagen AP, Karels CH, Schellingerhout JM, et al. Pain severity and catastrophising modify treatment success in neck pain patients in primary care. *Man Ther*. 2010; 15:267–272.

17 Kuijpers T, van der Windt DA, van der Heijden GJ, Bouter LM. Systematic review of prognostic cohort studies on shoulder disorders. *Pain*. 2004;109:420–431.

18 Kuijpers T, van der Windt DA, Boeke AJ, et al. Clinical prediction rules for the prognosis of shoulder pain in general practice. *Pain*. 2006;120:276–285.

19 Reilingh ML, Kuijpers T, Tanja-Harfterkamp AM, van der Windt DA. Course and prognosis of shoulder symptoms in general practice. *Rheumatology (Oxford)*. 2008;47:724–730.

20 Ryall C, Coggon D, Peveler R, et al. A prospective cohort study of arm pain in primary care and physiotherapy: prognostic determinants. *Rheumatology (Oxford)*. 2007;46:508–515.

21 Van Eerd D, Beaton D, Cole D, et al. Classification systems for upper-limb musculoskeletal disorders in workers: a review of the literature. *J Clin Epidemiol*. 2003;56: 925–936.

22 Van Tulder M, Malmivaara A, Koes B. Repetitive strain injury. *Lancet*. 2007;369: 1815–1822.

23 Burton AK, Kendall NA, Pearce BG, et al. Management of work-relevant upper limb disorders: a review. *Occup Med (Lond)*. 2009;59:44–52.

24 Huisstede BM, Miedema HS, Verhagen AP, et al. Multidisciplinary consensus on the terminology and classification of complaints of the arm, neck and/or shoulder. *Occup Environ Med*. 2007;64:313–319.

25 Feleus A, Bierma-Zeinstra SM, Miedema HS, et al. Management in non-traumatic arm, neck and shoulder complaints: differences between diagnostic groups. *Eur Spine J*. 2008;17:1218–1229.

26 Multidisciplinaire richtlijn aspecifieke Klachten Arm, Nek en/of Schouders. Utrecht, the Netherlands: Kwaliteitskoepel Medisch Specialisten; 2012. Available at: http://www.kwaliteitskoepel.nl/assets/structured-files/2012/multidicsrichtlijnaspecifiekeKANS19092012.pdf.

27 Miedema HS, Feleus A. Guideline "Non-specific symptoms of arm, neck and/or shoulders" [in Dutch]. *Ned Tijdschr Geneeskd*. 2013;157:A6249.

28 Pincus T, Kent P, Bronfort G, et al. Twenty-five years with the biopsychosocial model of low back pain-is it time to celebrate? A report from the Twelfth International Forum for Primary Care Research on Low Back Pain. *Spine (Phila Pa 1976)*. 2013;38:2118–2123.

29 Feleus A, Bierma-Zeinstra SMA, Bernsen RMD, et al. Management decisions in non-traumatic complaints of arm, neck, and shoulder in general practice. *Ann Fam Med*. 2009;7:446–454.

30 Observational studies: getting clear about transparency. *PLoS Med*. 2014;11: e1001711.

31 Hudak PL, Amadio PC, Bombardier C; The Upper Extremity Collaborative Group (UECG). Development of an upper extremity outcome measure: the DASH (Disabilities of the Arm, Shoulder and Hand) [corrected]. *Am J Ind Med*. 1996; 29:602–608.

32 Beaton DE, Katz JN, Fossel AH, et al. Measuring the whole or the parts? Validity, reliability, and responsiveness of the Disabilities of the Arm, Shoulder and Hand outcome measure in different regions of the upper extremity. *J Hand Ther*. 2001; 14:128–146.

33 Huisstede BM, Feleus A, Bierma-Zeinstra SM, et al. Is the Disability of Arm, Shoulder, and Hand questionnaire (DASH) also valid and responsive in patients with neck complaints. *Spine (Phila Pa 1976)*. 2009; 34:E130–E138.

34 Koes BW, van Tulder M, Lin CW, et al. An updated overview of clinical guidelines for the management of non-specific low back pain in primary care. *Eur Spine J*. 2010; 19:2075–2094.

35 Ware JJ, Kosinski M, Keller SD. A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. *Med Care*. 1996;34:220–233.

36 Terluin B, van Marwijk HW, Ader HJ, et al. The Four-Dimensional Symptom Questionnaire (4DSQ): a validation study of a multidimensional self-report questionnaire to assess distress, depression, anxiety and somatization. *BMC Psychiatry*. 2006;6:34.

37 Feij JA, Doorn CD, van Kampen D, et al. Sensation seeking and social support as moderators of the relationship between life events and physical illness/psychological distress. In: Winnubst JA, Maes S, eds. *Lifestyles, Stress and Health*. Leiden, the Netherlands: DSWO Press; 1992:285–302.

38 Spinhoven P, Ter Kuile M, Linssen A. *Coping With Pain Questionnaire (CPV): Guide/Experimental Version*. Lisse, the Netherlands: Swets & Zeitlinger; 1994.

39 Goubert L, Crombez G, Van Damme S, et al. Confirmatory factor analysis of the Tampa Scale for Kinesiophobia: invariant two-factor model across low back pain patients and fibromyalgia patients. *Clin J Pain*. 2004;20:103–110.

40 Van Poppel MN, de Vet HC, Koes BW, et al. Measuring sick leave: a comparison of self-reported data on sick leave and data from company records. *Occup Med (Oxford)*. 2002;52:485–490.

41 Bot SD, Terwee CB, van der Windt DA, et al. Internal consistency and validity of a new physical workload questionnaire. *Occup Environ Med*. 2004;61:980–986.

42 Karasek R, Brisson C, Kawakami N, et al. The Job Content Questionnaire (JCQ): an instrument for internationally comparative assessments of psychosocial job characteristics. *J Occup Health Psychol*. 1998;3: 322–355.

43 Muthén B. Latent variable analysis, growth mixture modeling and related techniques for longitudinal data. In: Kaplan D, ed. *Handbook of Quantitative Methodology for the Social Sciences*. Newbury Park, CA: Sage Publications; 2004:345–368.

44 Muthén L, Muthén B. *Mplus User's Guide*. 7th ed. Los Angeles, CA: Muthén & Muthén; 2012.

45 Jung T, Wickrama K. An Introduction to latent class growth analysis and growth mixture modeling. *Soc Personal Psychol Compass*. 2008;2:302–317.

46 Hoekstra T, Barbosa-Leiker C, Koppes LL, Twisk JW. Developmental trajectories of body mass index throughout the life course: an application of latent class growth (mixture) modelling. *Longit Life Course Stud*. 2011;2:319–30.

47 Geiser C. *Data Analysis With Mplus*. New York, NY: Guilford Press; 2012.

48 Terluin B. De Vierdimensionale Klachtenlijst (4DKL) in de huisartspraktijk: psychodiagnostisch gereedschap. *De Psycholoog*. 1998;33:18–24.

49 Aasheim T, Finsen V. The DASH and the QuickDASH instruments: normative values in the general population in Norway. *J Hand Surg Eur Vol*. 2014;39:140–144.

50 Hunsaker FG, Cioffi DA, Amadio PC, et al. The American Academy of Orthopaedic Surgeons outcomes instruments: normative values from the general population. *J Bone Joint Surg Am*. 2002;84:208–215.

51 Kristman V, Manno M, Cote P. Loss to follow-up in cohort studies: how much is too much? *Eur J Epidemiol*. 2004;19:751–760.

52 Hoekstra T. *Applied Latent Class Models for Epidemiology*. Amsterdam, the Netherlands: Free University Medical Center; 2013.

53 Schellingerhout JM, Heymans MW, Verhagen AP, et al. Prognosis of patients with nonspecific neck pain: development and external validation of a prediction rule for persistence of complaints. *Spine (Phila Pa 1976)*. 2010;35:E827–E835.

54 Bot SD, van der Waal JM, Terwee CB, et al. Predictors of outcome in neck and shoulder symptoms: a cohort study in general practice. *Spine (Phila Pa 1976)*. 2005;30: E459–E470.

55 Carroll LJ, Hogg-Johnson S, van der Velde G, et al. Course and prognostic factors for neck pain in the general population: results of the Bone and Joint Decade 2000–2010 Task Force on Neck Pain and Its Associated Disorders. *Spine (Phila Pa 1976)*. 2008;33(4 suppl):S93–S100.

56 McLean SM, May S, Moffett JK, et al. Prognostic factors for progressive non-specific neck pain: a systematic review. *Phys Ther Rev*. 2007;12:207–220.

57 van der Windt DA, Koes BW, Boeke AJ, et al. Shoulder disorders in general practice: prognostic indicators of outcome. *Br J Gen Pract*. 1996;46:519–523.

58 Vos CJ, Verhagen AP, Passchier J, Koes BW. Clinical course and prognostic factors in acute neck pain: an inception cohort study in general practice. *Pain Med*. 2008; 9:572–580.

59 Hill JC, Whitehurst DG, Lewis M, et al. Comparison of stratified primary care management for low back pain with current best practice (STarT Back): a randomised controlled trial. *Lancet*. 2011; 378:1560–1571.

60 Nicholas MK, George SZ. Psychologically informed interventions for low back pain: an update for physical therapists. *Phys Ther*. 2011;91:765–776.

61 Beneciuk JM, George SZ. Pragmatic implementation of a stratified primary care model for low back pain management in outpatient physical therapy settings: two-phase, sequential preliminary study. *Phys Ther*. 2015;95:1120–1134.